

Appl. No. 10/708,983
Amdt. dated March 28, 2006
Reply to Office action of December 29, 2005

REMARKS/ARGUMENTS

Claim 5 is rejected under 35 U.S.C. 112. Claims 1-7 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Bruce (US Patent 4,978,594).

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1. Objection/Rejection of claim 5:

Claim 5 is objected to because of the following informalities: the phrase "and the less" is not correct, perhaps "and less". Appropriate correction is required.

10 Claim 5 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as at the time the application was filed, had possession of the claimed invention. Claim 5 recites that the photoresist absorbs light with a wavelength of "248 nm and the less". The specification teaches that the light is UV while the range recited covers wavelengths outside of that taught by the specification.

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Response:

20 According to the specification of this application, it clearly describes that "the composite photoresist structure 30 can be used in a photolithography process *utilizing light sources with wavelengths shorter than 248nm in deep UV regions* (para. [0020], lines 11-13)". In order to avoid misunderstanding, claim 5 is amended as shown in the above "Listing of Claims" section, which lists the same description for light source as that in the specification. No new matter is introduced. Therefore, the rejection or objection of

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claim 5 should be overcome. Reconsideration of claim 5 is politely requested.

2. Rejection of claims 1-7 under 35 U.S.C. 102(b):

Claims 1-7 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Bruce
5 (US Patent 4,978,594). Bruce teaches a process of forming a pattern photolithographically.
Example 1 teaches the process whereby a silicon wafer (claim 7) is cleaned and a layer of
polymer is applied (first organic layer). A sacrificial layer of silicon nitride is applied
(claim 4) followed by a fluorine-containing polymer and a photoresist layer. The
photoresist is exposed to ultraviolet light (encompassed by the range recited in claim 5)
10 and developed to form an etching mask. An oxygen plasma (claim 3) is then used to etch
the fluorine-polymer layer followed by etching the silicon nitride layer. Figure 2 depicts
the layers as applied before processing occurs.

Response:

15 **(1) Claim 1:**

According to claim 1 and Figs.4E-4F of this application, the method of
fabricating a semiconductor device comprises sequentially forming a first organic
layer 30a, a sacrificial layer 30b, and a second organic layer 30c on a substrate 42,
wherein the first organic layer 30a, the sacrificial layer 30b and the second organic
20 layer 30c compose a composite photoresist structure 30. Then, a
photolithography-etching process (PEP) is performed to pattern the second organic
layer 30c. The patterned second organic layer 30c is taken as an etching mask for
performing an etching process to etch the sacrificial layer 30b. After removing the
patterned second organic layer 30c, the sacrificial layer 30b is taken as an etching

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mask for etching the first organic layer 30a. Then, the sacrificial layer 30b and the first organic layer 30a are taken as an etching mask for etching the substrate 42 *for transferring the predetermined pattern to the substrate 42*. Finally, the patterned first organic layer 30a is totally removed, which means the sacrificial layer 30b is removed, too. Accordingly, *all of the first organic layer, the sacrificial layer, and the second organic layer are removed after the substrate is patterned* according to claim 1 of this application, as shown in Fig.4F.

In one word, claim 1 of this application has at least the following three characteristics: *(a) the first organic layer is clean removed after the pattern-transferring process; (b) the substrate is patterned with the predetermined pattern; and (c) the sacrificial layer formed on the first organic layer will be removed together with the first organic layer after the pattern-transferring process.*

Referring to the specification and Figs.1-5 of Bruce's disclosure, he teaches sequentially forming a fluorinated polyimide 16 and a photoresist 18 on a Si substrate 10 which has a planarization polymer 12 and a silicon nitride etch-stop layer 14 thereon. Then, a photolithography process is performed to transfer a pattern to the photoresist 18. The photoresist 18 is taken as a mask to perform an O₂ RIE process to transfer the pattern to the fluorinated polyimide 16. Then, another etching process is performed to etch the silicon nitride 14 or the planarization polymer 12 by taken as the fluorinated polyimide 16 as a mask, followed by metallization by sputtering or evaporation and subsequent lift-off in NMP to provide metallization pattern (col.5, lines 43-50). *Consequently, Bruce teaches utilizing the resist 18 and the fluorinated polyimide 16 to transfer the pattern to the silicon nitride 14 and the planarization polymer 12, wherein the silicon nitride 14 and the planarization polymer 12 are reserved on the Si substrate 10 for serving as dielectric layers of a metal interconnect structure. Accordingly, the silicon nitride 14 and the planarization*

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polymer 12 are not sacrificial layers and will not be removed after the pattern-transferring process. And the Si substrate 10 is never patterned with the pattern exposed on the photoresist 18 or the silicon nitride 14.

5 As a result, *Bruce never teaches or discloses etching the Si substrate 10 (as the substrate of claim 1, mentioned by the Examiner) to form the predetermined pattern in the Si substrate 10 or discloses removing the planarization polymer 12 (as the first organic layer, mentioned by the Examiner) after the pattern-transferring process.* Furthermore, since Bruce only teaches forming a silicon nitride 14 which
10 *will be kept on the Si substrate 10 for serving as a dielectric layer, he never teaches or disclose forming a sacrificial layer on the first organic layer* while those skilled in the art may realize "a sacrificial layer" will be removed after the fabrication process. Accordingly, Bruce's application does not disclose the above-mentioned three characteristics in claim 1 of this application. Therefore, claim 1 of this
15 application is quite different from Bruce's disclosure and should be patentable regarding 35 U.S.C. 102(b). Reconsideration of claim 1 is politely requested.

(2) Claim 2:

20 The Examiner did not mention the reason of the rejection of claim 2 of this application in the above-identified Office action.

25 Applicant would like to describe the difference between claim 2 and Bruce's application for standing for the patentability of claim 2. Claim 2 of this application describes that the first organic layer is made of a material selected from the group consisting of low dielectric organic materials and spin-on glass (SOG). However, *Bruce never mentions the term "spin-on glass" or the term "SOG" in his disclosure, or mentions the planarization polymer 12 has a low dielectric constant, as the*

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functionality of low dielectric organic materials. Therefore, Bruce's application does not teach the limitations in claim 2 of this application. As a result, reconsideration of claim 2 is respectfully requested.

5 **(3) Claim 5:**

 The amended claim 5 has the limitation that the second organic layer is made of
an organic photoresist material capable of absorbing light sources with wavelengths
shorter than 248nm in deep UV regions (according to para. [0020], lines 11-13 of
this application). However, Bruce only discloses that the resist 18 is patterned by
10 using UV with wavelength of 365nm (Fig.3 and col.3, line 24, and col.7, line13) or
mid UV (col.6, line 36). In general knowledge, those skilled in the art may realize
"UV" means the light with wavelength up to 350nm. Since Bruce never teaches
specifically using a light source with wavelength less than 248nm or using deep UV
for exposing the photoresist 18, he does not disclose all the limitations in claim 5 of
15 this application. Therefore, applicant believes claim 5 should be allowable.
Reconsideration of claim 5 is hereby requested.

(3) Claims 2-4, and 6-7:

 Claim 4 is amended to describe that the sacrificial layer is made of silicon
20 nitride. Because claims 2-4 and 6-7 are dependent upon claim 1, they should be
allowable if claim 1 is allowable. Reconsideration of claims 2-4 and 6-7 are thereby
requested.

3. Introduction of new claims:

25 The original claim 4 is re-written as the amended claim 4 and the new claim 8. No
new matter is introduced. Bruce is silent about forming a sacrificial layer made of silicon
oxide on a first organic layer, thus claim 8 should be allowable.

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Claim 9 describes that the thickness of the first organic layer is larger than that of the second organic layer. According to this application, *the thick first organic layer plays a role for serving as an etching mask during the process of etching the substrate thereunder, for insuring that the composite photoresist structure that comprises the first organic layer and the second organic layer is thick enough to block following etching processes.* Therefore, the thickness of the second organic layer can be adjusted to be thinner according to wavelengths of light sources used in exposure processes so that the composite photoresist structure is suitable for sub-micron pattern transfers in semiconductor processes (Figs.3-4F, para.[0010], and para.[0020]). *Bruce is silent about describing the thicknesses of the planarization polymer 12 and the fluorinated polyimide 16 and never mentions the planarization polymer 12 has to be thick enough for serving as an etching mask to etch the Si substrate 10.* Therefore, Bruce's application does not disclose the contents of the new claim 9 and cannot provide the advantage or functionality of the thick first organic layer in the composite photoresist structure. Consequently, claim 9 should be allowable.

Claim 10 describes the sacrificial layer is removed concurrently while etching the substrate (Figs.4D-4E. and para.[0020], lines 1-6). Since the silicon nitride 14 of Bruce's is kept on the Si substrate 10 and the Si substrate 10 is never etched through the pattern-transferring process in Bruce's application. Claim 10 should be allowable.

Claim 11 further describes the first organic layer of this application is totally clean removed by use of plasma, which is not disclosed in Bruce's application. Therefore, claim 11 should be allowable.

Claims 12-14 describes an anti-reflection layer is formed on the sacrificial layer before forming the second organic layer. The anti-reflection layer comprises organic

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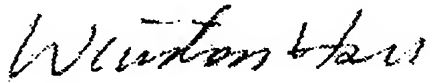
materials or inorganic materials (according to para.[0021], lines 2-15), which is not taught by Bruce's application, thus claims 12-14 should be allowable.

5 All the new claims 8-14 are fully supported by the specification and figures of this application and no new matters are introduced. Accordingly, acceptance and consideration of the new added claims 8-14 are politely requested.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

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Sincerely yours,



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20 Note: Please leave a message in my voice mail if you need to talk to me. (The time in D.C. is 13 hours behind the Taiwan time, i.e. 9 AM in D.C. = 10 PM in Taiwan.)